In the Matter of	)	
	)	
Section 68.4(a) of the Commission's Rules	)	
Governing Hearing Aid	)	**WT Docket No. 01-309**
Compatible Telephones	)	**RM-8658**
	)	

COMMENTS
OF THE
ASSOCIATION OF ACCESS ENGINEERING SPECIALISTS
(AAES)

The Association of Access Engineering Specialists (AAES), a unit of the National Association of Radio and Telecommunications Engineers (NARTE), thanks the FCC (Commission) for the opportunity to provide these comments in response to the Notice of Proposed Rulemaking (NPRM), In the Matter of Section 68.4(a) of the Commission's Rules Governing Hearing Aid Compatible Telphones, FCC 01-309, released November 14, 2001, regarding proposed changes to the exemption for public mobile telephones to the rules governing Hearing Aid Compatibility (HAC).[1] We appreciate this opportunity to provide the Federal Communications Commission (FCC or Commission) with comments on this matter. AAES is an association of engineers and accordingly we will focus our comments on the technical and practical aspects of the proposed rulemaking.

AAES was founded to assist in the development of the field of telecommunications and information technology access, provide education in access design and encourage dialogue between all affected parties with the purpose of constructing consensus solutions to access issues.

The concept for AAES was developed during the deliberations of the Telecommunications Access Advisory Committee (TAAC), which was convened by the Access Board. A number of the participants felt that there was a need to establish a neutral coordination point, where all affected parties could meet and develop the field of telecommunications access. From these discussions AAES was created as a cooperative effort of the National Association of Radio and Telecommunications Engineers (NARTE).

AAES is a technical society with individual membership. It is an organization where those working in the many aspects of this field can join together, dialogue, reach consensus and develop the field. Among the AAES members are individuals from disability organizations, telecommunications and information technology equipment manufacturers, telecommunications carriers, academia, research centers, various fields of adaptive technology and other related areas.

I. The FCC should base its decision on facts not hypothesis

We are gratified and appreciative of the Commissions historic and continuing support for disability access. We applaud and encourage this policy believing it is good and wise policy for not only the disability community but society in general. Providing for accessibility benefits the disability community but also makes their talents and contributions available to the rest of society. Providing accessibility is extremely important and we are very pleased that this Commission is continuing to recognize and support this policy.

FCC Chairman Powell has wisely recognized that excellence and depth in engineering expertise is vital to the Commissions ability to fulfill its mission. We recognize and applaud the recent increase in the staffing at the Commission laboratory. Increasing engineering staff is a vital and correct policy. It will be our observation in these comments that this policy

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1 See 47 U.S.C. §610(b)(2)(B)

has not reached the stage where engineering expertise is effectively integrated into the Disability Rights Office (DRO). We suspect that this lack of technical support explains the significant flaws in this proposed rulemaking.

Good policy and a noble cause are not enough. There must be rigor and excellence in implementation. The engineering must be done well. It is our belief that some common perceptions surrounding this current rulemaking are flawed. Those unquestioned assumptions and a lack of engineering resources appear to be the reason for this deeply flawed proposed rulemaking.

As we have begun we will be frank in our comments. We hope that such candor will not be offensive. However, to challenge long held assumptions is not easy. Comfortable ideas do not quickly give way to reality. Therefore we will be blunt because we support the Commissions policy and intentions and deeply desire to see accessibility provided to the telecommunications network, and in this context accessibility for people with hearing loss and hearing aid users.

II. The Commission should review the effectiveness of the wireline Hearing Aid Compatibility rules

The intent of the 1988 Hearing Aid Compatibility Act (HAC Act) and of the Commisison in promulgating its associated rules included in 47 CFR 68 (Part 68) is clearly that people with hearing loss and hearing aid wearers in particular be able to use the telephone. The rules have been in force for some time. How effective have they been? For how many people has the objective been reached?

Before extending these rules to a new technology the success of the these regulations on wireline telephones should be examined objectively.

The technical core of the FCC's HAC regulations is found in 47 CFR 68.316[2], which is introduced with the following statement,

2 For some telephones the volume control requirements of 47 CFR 68.317 also apply. The focus of our comments

> **A telephone handset is hearing aid compatible for the purposes of this section if it complies with the following standard,…**

This provision requires that telephone handsets emit a magnetic signal at a certain amplitude and frequency response. That is all! The EIA RS-504 standard, which is provided in its entirety in Part 68.316, states in its scope:

> **A major reason for incompatibility has been the lack of handset magnetic field intensity requirements.**

This provision fulfills its purpose, but that purpose is far more narrow than assuring that hearing aid wearers can effectively use the telephone. Has this very specific purpose resulted in wireline hearing aid compatibility? **Before promulgating new rules the Commission should gather objective data on how effective the current rules are in achieving the desired ends.**

III. Only a fraction of people with hearing loss are currently served by the HAC requirements.

In Commissioner Abernathy's statement attached to this NPRM states that more than 28 million American have a hearing loss.[3] We will accept this figure for our analysis here.

However, it should be note that the US Census Bureau in its 1997 report on disability demographics[4] 7,966,000 people over age 15 who have difficulty hearing normal conversation. The National Center for Health Statistics of the Centers for Disease Control reports that in 1996 8.3% or 22 million people in the US had a hearing loss.[5] This tremendous range in the demographic data points to the need to understand what portion of this group benefits or potentially can benefit from any proposed action.

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will be on the T-Coil requirements in 47 CFR 68.316.

3 This number is quoted from comments of Self Help for Hard of Hearing People (SHHH) provided in the Matter of Reallocation of the 216-220 MHz (filed February 15, 2001).

4 Available at www.census.gov/prod/2001pubs/p70-73.pdf

5 The National Center for Health Statistics of the Centers for Disease Control reports that in 1996 22 million people in the US had a hearing loss. See www.cdc.gov/nchs/fastats/diable.htm.

The Census Bureau report contains the following data:

Number (000)	Percentage	
		People Over 15 years old:
7,966	3.8%	With Difficulty hearing normal conversation
7,132	3.4%	Those difficulty that is not severe
832	0.4%	Those with severe difficulty
		People between 15-64 years old:
3,416	1.63	With Difficulty hearing normal conversation
3,189	1.52	Those difficulty that is not severe
227	0.11	Those with severe difficulty

The US Centers for Disease Control (CDC) in its report, "Prevalence of Disabilities and Associated Health Conditions Among Adults --- United States, 1999"[6] gives the following:

Number (000)	Percentage	People with difficulty hearing normal conversation
6,932	3.5%	Over 18 years old
3,013	1.8%	18 – 64 years old
3,919	12.0%	Over 65 years old

It should be noted that both the Census Bureau and CDC data appears to include people who are deaf.[7] At some point in the continuum from normal hearing to total deafness the strategy for providing accessibility changes from hearing enhancement, the topic of this NPRM, to two-way text messaging, TTY. However, that point of demarcation is not defined in between hearing loss and deafness. From an engineering standpoint, it is important to bound the problem being addressed. This NPRM is attempting to address the needs of people with less than normal hearing to some point at which two-way text messaging, TTY because the method of choice. Generally that transition is made at the point where a person either cannot recognize speech at

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6 Published Feb. 23, 2001. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5007a3.htm.
7 Additional statistical data is available at from the Disability Statistics Center, University of California-San Francisco, http://dsc.ucsf.edu/ucsf..

all, even with amplification or where the severity of the loss requires an inordinate degree of amplification. **The Commission should clearly identify the intended beneficiaries of this rulemaking so that the recommended analysis of effectiveness is not clouded by inclusion of people for whom hearing enhancement is not likely to be effective, such as those who are almost deaf or whose hearing impairment would not benefit from the proposal.** We anticipate that this NPRM is attempt to address the needs of people who cannot recognize normal speech, generally at about 65 dB (SPL), but can understand amplified speech at some level under 90 dB (SPL). This latter number, 90 dB (SPL) will be open to discussion by the experts but it is important that some consensus level be identified if a proper analysis is to be performed. The point is, who is intended to benefit and do the facts support that the proposal will indeed benefit them?

Of the 28 million people with hearing loss about 5 million, or 18%, use hearing aids.[8] Of those, as stated in the NPRM, about 20% or about 1 million have T-Coils. So of the people with hearing loss about 6% are equipped to benefit from this NPRM. Of those, how many find the T-Coil effective?

Our members regularly and repeatedly get reports from users for who the T-Coil is not effective. Many people purchase hearing aids with T-Coils, find them ineffective and never use them. Nobody knows what percentage of T-Coil owners find them effective. However, to provoke the needed fact-finding we will state the opinion, based on the reports of our members that only 10-50% of people with T-Coil equipped hearing aids find them effective and use them on a regular basis. So this NPRM is hoping to benefit somewhere between 1% and 3% of people with hearing loss! We believe a better solution can be found.

Percentage	Number (000)	Description

8 In fact 5 million is a rounded estimate. The National Center for Health Statistics of the Centers for Disease Control reports that in 1994 4.5 million people used some type of device to help with their hearing. The most common type of device used was a hearing aid. See www.cdc.gov/nchs/fastats/diable.htm.

100%	28,000	People with Hearing Loss (FCC Number)
18%	5,000	Hearing Aid Users
6%	1,000	Hearing Aid Users with T-Coils
1-3%	166-500	Regular T-Coil users

IV. For many people T-Coils don't work very well.

These comments coming from an association of access engineers may sound like an attack on "mom and apple pie". However, to use the analogy, we are only going to say that in this day the clothes dryer really does work better than mom's fondly remembered clothes line. Given today's lifestyle it may be wise to use a little less sugar and butter in that well appreciated apple pie.

In the 1940's the T-Coil was developed allowing people to get far better access to their telephones than they could obtain by acoustic coupling. The T-Coil was made possible because those old handsets leaked a significant amount of magnetic flux. One way to describe this is that these old telephones contained an accidental AM radio. This low frequency AM radio was appealing because it was cheap (read free) and widely available. Compared to the poor acoustic performance, by today's standards, of those hearing aids the T-Coil was a significant improvement.

However this accidental AM radio never has worked very well. The Commission certainly recognizes that radio has come a long way from AM. The general consumer has called for FM radio, digital radio and a whole host of technical improvements and innovations. The poor old T-Coil is still the same today as it was then.

The T-Coil AM radio is very sensitive to interference from everything from computer monitors and florescent lighting to mobile phones and wireless networks. Some of the

better hearing aids do provide some filtering on their T-Coils. However, in its reception band the AM based T-Coil cannot be protected. This sensitivity to noise is one of the reasons the general population enthusiastically received FM radio. It is not uncommon to find a T-Coil user who cannot use their T-Coil in the office because of the lights, or computer monitor.

It may surprise many but the T-Coil also makes everyone sound like Donald Duck. This accidental AM radio emphasizes the higher frequency end of the spectrum so that all voices sound high pitched. Some of the better hearing aids do provide active compensation and correct for this. However, many T-Coil users find that they would rather use their acoustic mode whenever possible. For many, whose hearing aids don't compensate, they just don't like listening to Donald Duck all the time.

The T-Coil is a public broadcast, easily received on very simple radio receivers. There is no security. The signal sent from the phone travels far past the user, making it relatively simple to monitor the conversation on any hearing aid compatible phone. **It is important that the Commission recognize that the security of every telephone it places under this requirement will be compromised.** It is very important that the Commission fully informs itself of all the consequences of its actions and evaluates their total impact, both positive and negative.

There is no standard orientation for the receiving element in a T-Coil. It may be aligned with the transmitting element in the telephone and it may be cross-polarized. When the two are aligned the reception is optimized. However, when the transmission and receiving elements are not aligned the quality of the transmission is significantly degraded. This is one factor, among several, that is important in explaining why some T-Coil users have very satisfactory reception and others soon stop using their T-Coils.

T-Coil performance in general is degrading over time. Hearing aids are generally getting smaller. Because of this there is less room for the T-Coil receiver "antenna" and so these are getting smaller. Also, hearing aids are moving further into the ear. In some cases hearing

aids are completely contained in the ear canal, these are called completely-in-the-canal aids. This moves the T-Coil receiver further away from the handset and degrades reception. Then, as mentioned above, more and more electronic equipment is coming into use so the amount of interference T-Coils are experiencing is increasing.

While T-Coil performance has generally degraded[9] the acoustic performance of hearing aids has improved tremendously. It is to be remembered that the T-Coil originally came about because it provided a better solution than acoustic coupling. The question today is, is that statement still generally true? No doubt for some it is true that T-Coil performance is better than acoustic coupling. But is that true to 1%, 3%, 50% of T-Coil users? If the answer is, as we suspect, on the lower end of the range, then the Commission should carefully look at alternative solutions so as to better provide for a wider portion of the population with hearing loss.

V. The proposed rule clearly misunderstands the ANSI standard and appears unaware of important changes that have taken place.

This NPRM is sadly lacking in its understanding of the ANSI standard, the technical literature on this issue and appears to be unaware of the many important improvements that are taking place to resolve this issue. The NPRM quickly dismisses the ANSI standard, with the statement:

> 7. To date, no technical standards have been developed for wireless hearing aid compatibility, ….

9 It is important to note that some manufacturer have introduced important innovations in their T-Coil circuits. Active amplifiers with frequency compensation and band limiting as significant improvements. These innovations are to be noted and applauded. However, the Commission should inform itself of the relative prevalence of these improved devices as opposed to those without such advanced features.

The section then goes on to refer to ANSI C63.19 as only a measurement standard. However, the opening sentences of ANSI C63.19 section 1.1, scope, clearly states:

> This standard applies to both wireless communications devices (WD) and hearing aids. It sets forth uniform methods of measurement and parametric requirements for the electromagnetic and operational compatibility and accessibility of hearing aids used with wireless communications devices, including cordless, cellular and Personal Communications Service (PCS) phones, operating in the range of 800 MHz to 3 GHz.

First, it should be noted that the FCC itself voted to adopt ANSI C63.19. The committee specifically called the Disability Rights Office during the final ballot process. The DRO was informed that the ballot was in process that the FCC representative to ANSI ASC 63 would be voting and that their views should be incorporated in that vote. The FCC voted for the standard without comment. Moreover, during the first year and a half of the standards development quarterly briefings were given to the Commission staff as to the content and progress of the standard. The Commissions routine comment was that the work was exactly what it hoped to see and that the effort should be completed as quickly as possible. It is therefore distressing to find that the Commission staff now appears to be unaware of even the first sentence in the standard.

VI. The industries appear to be resolving the problem, but not in the expected way

Over the course of the last eight years a significant body of literature has developed over this issue.[10] What the technical analysis reveals is not a single problem but a

10 The following is only a partial sampling of the literature available on this issue:

- European Telecommunications Standards Institute, "GSM EMC Considerations", ETSI Technical Report GSM 05.90, Valbonne Cedex, France, 1993.
- Joyner, KH, Wood, M, Burwood, E, Allison D., Le Strange, R., "Interference to Hearing Aids by the New Digital Mobile Telephone System, Global System for Mobile Communications Standard", National Acoustic Laboratories, Australian Hearing Services, 1993.
- European Hearing Instruments Manufacturers Association, "Hearing Aids and GSM Mobile Telephones: Interference Problems, Methods of Measurement and Levels of Immunity", GSM Project Final Report, Wemmel, Belgium, EHIMA, 1995.
- Berger, HS, "Compatibility Between Hearing Aids and Wireless Devices" Electronic Industries Forum, Boston, Ma. , May, 1997.
- Berger, HS, "Hearing Aid and Cellular Phone Compatibility: Working Toward Solutions", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Berger, HS, "Hearing Aid Compatibility with Wireless Communications Devices" IEEE International Symposium on Electromagnetic Compatibility, Austin, Tx. August, 1997.
- Berger, HS, "Wireless Hearing Aid Compatibility", Self-Help for Hard of Hearing People Annual Conference, Washington, D.C., June, 1998.
- Bisgaard, Nikolai, "The European Experience", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Byrne, D and Burwood, E, "The Australian Experience: Global System for Mobile Communications Wireless Telephones and Hearing Aids", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Harkins, Judy, " Practical Information for Audiologists on Access to Wireless Telephones", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Killion, M, Teder, H and Thoma, R, "Suitcase Lab Measurement of Digital Cellphone Interference Levels on Hearing Aids", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Levitt, H, Harkins, J, Singer, B and Yeung, E, "Field Measurements of Electromagnetic Interference in Hearing Aids", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Ravindran, A, Schlegel, RE, Grant, H, Matthews, P, Scates P., "Evaluation of the Interaction between Wireless Phones and Hearing Aids, Phase I: Results of the Clinical Trials", EMC Report 1996-2, Center for the Study of Wireless Electromagnetic Compatibility, University of Oklahoma, 1996.
- Ravindran, A, Schlegel, RE, Grant, H, Matthews, P, Scates P., "Measures of Interference to Hearing Aids from Digital Phones", Hearing Journal, 50:32-34, 1997.
- Ross, Mark, "Wireless Telephones and Hearing Aids: An Overview", Wireless Telephones and Hearing Aids: New Challenges for Audiology, Journal of the American Academy of Audiology, Vol. 12 No. 6, June, 2001.
- Schlegel, RE, Grant, H, "Modeling the Electromagnetic Response of Hearing Aids to Digital Wireless Phones", IEEE Transactions on Electromagnetic Compatibility, 42:347-357, 2000.
- Schlegel, RE, Srinivasan, S, Grant, H, Shebab, RL, Raman, S., "Clinical Assessment of Electromagnetic Compatibility of Hearing Aids and Digital Wireless Phones", Proceedings of the 42nd Annual Meeting of the Human Factors and Ergonomics Society, 1023-1027, 1998.
- Srinivasan, S, Schlegel, RE, Grant, H, "Evaluation of the Interaction between Wireless Phones and Hearing

complex of related problems. To list just a few of the problems isolated and identified in the literature:

- RF interference between some phones and hearing aids
- Low frequency interference between some phones and hearing aids
- Signal purity problems with some T-Coil signals
- Signal distortion problems with some T-Coil signals
- Acoustic coupling problems
- Acoustic feedback problems
- T-Coil signal polarization problems
- Lack of standardization on hearing aid T-Coil amplification
- Lack of standardization on hearing aid T-Coil frequency correction
- Dynamic range problems for some people with hearing loss
- Inability to identify speech acoustically for some people
- Increased difficulty experienced by some recognizing speech at amplified levels

A careful sampling of the comments to the Commission will reveal that consumers are reporting different problems. Some report interference problems. Others report that they can hear nothing from a mobile phone. This later is a different problem that receiving interference. Still other report problems related to sales support, customer support and availability of information.

As has been reported at the later stages of the standard development the University of Oklahoma Center for the Study of Wireless EMC performed a study of the effectiveness the standard in dealing with the issue of wireless HAC. The following statement is found in the summary of that study:

> Thus, thirteen of the eighteen participants responded as predicted by the acoustic measurements made with actual wireless phones. The remaining participants experienced difficulties unrelated to wireless phone interference (severe hearing loss or excessive feedback).[11]

Aids, Phase II-B: Clinical Determination of the Speech-to-Interference Ratio", EMC Report 1997-2, Center for the Study of Wireless Electromagnetic Compatibility, University of Oklahoma, 1998.

11 Schlegel, RE, Grant, H, Matthews, P, Scates P., "Evaluation of the Interaction Between Wireless Phones and Hearing Aids: Phase III-B: Subjective Validation Study", Center for the Study of Wireless Electromagnetic Compatibility, University of Oklahoma, 2001. Available at www.ou.edu/engineering/emc.

Thus 28% of the participants in the study had difficult using the telephone for reasons unrelated to the wireless telephones. In that same study 34% of the hearing aids worked with all the telephones. Other aids worked well with some of the telephones used in the study. In fact 68% of the hearing aid / mobile telephone combinations performed at recommended levels. It would be a tragedy if through lack of current and accurate information the Commission turned away from the cooperative efforts and the consensus standard process if this process is resulting in anything like 68% resolution of the issue. It would be even more tragic if in fact the remaining 32% is largely due to factors unrelated to the wireless telephone. We would like to be clear. It is our opinion that the process started with the FCC Summit and focused since then in the development of the ANSI standard is not complete. We believe that problems remain particularly in less expensive hearing aids and with certain areas of the market, such as very high gain hearing aids. However, it is also our belief that if the decision is based upon information about the current situation and dated information is excluded then the cooperative process initiated by the Commission in 1995 will be judged to have been a great success and one to be further encouraged and refined. We also honestly state that data on the current market is currently incomplete and encourage the Commission to secure such information before making a decision in this NPRM.

Complicating the picture further is the complex variety of technologies and configurations offered by both the mobile phone and hearing aid industries.

Given this complexity, it should not be surprising that the "solution" is proving to be a variety of solutions. A number of changes and innovations have been offered on the market. Each of these addresses a part of the market and in total they appear to be quickly resolving the problem in total.

The most difficult part of a market driven, voluntary industry solution such as is being observed is tracking it. There is no central planning or reporting mechanism. There is not

one place to which progress is being reported. Rather piece-by-piece the issues listed above, and others are being addressed and the problem is receding.

That problems remain in market niches is clearly true. These should be identified and addressed expeditiously and effectively. However, our strong impression is that the cooperative process started by the FCC Hearing Aid Summit in 1995 and supported by both industries is being effective and should be encouraged to complete its tasks.

The RF interference problem is one of the most prominent of the issues involved in the NPRM. Related to its August 2001 meeting in Chicago the ANSI C63.19 working group sought information on what progress had been made on this issue. Mr. Gert Ravn, convener of IEC 118-13 committee on hearing aid immunity and an executive at Delta Acoustics Laboratory, which is used by many hearing aid manufacturers is significant and typical of the information received:

> Today most hearing aids released from most hearing aid manufacturers has immunity to RF signals which are more than 100 times better than in the early 90ties. Most new hearing aids has reached the goal to be compatible…

When asked to further clarify his statement Mr. Ravn stated:

> We carry out quite a lot of acoustic and EMC testing for most of the major hearing aid companies, probably 50 - 70 hearing aid types pr. year. The results by the manufactures for technical documentation, type approval, data sheets, homologation, CE marking and labeling etc. My general impression based on this is, that almost all hearing aids put on the market today are cell-phone compatible. Therefore we are primarily facing the 5-10 years of delay with low-immunity hearing aids sold in the early to mid-nineties, but still being worn by users today. The percentage of users with

cell-phone compatible hearing aids depends on the age of their hearing aids. You are welcome to quote me for that.

If this information is correct this NPRM is attempting to solve a solved problem. The problem remaining will not be solved by regulation but rather with consumer education and expansion of the solutions that are available into market niches which still need to be addressed. However, before these next steps can be taken better information is need on where the problem is solved and where further efforts are needed.

VII. There is significant and important innovation taking place

Significant and exciting innovations are taking place all through both industries. A brief patent search reveals the following innovations patented on this issue in the last few years. Each of these patents is the end result of a significant research effort. The consumer is best served if the Commission encourages innovation and product improvement.

1) **6,009,311 -** Method and apparatus for reducing audio interference from cellular telephone transmissions

2) **6,031,923 -** Electronmagnetically shielded hearing aids

3) **5,640,457 -** Electromagnetically shielded hearing aid

4) **6,320,959 -** Hearing aid telephone interconnect system

5) **6,311,155 -** Use of voice-to-remaining audio (VRA) in consumer applications

6) 6,307,944 - System for mitigating RF interference in a hearing aid

7) 6,307,151 - Technique for reducing low frequency interference noise

8) **6,095,820 -** Radiation shielding and range extending antenna assembly

9) **6,068,589 -** Biocompatible fully implantable hearing aid transducers

10) **6,022,311 -** Apparatus and method for a custom soft-solid hearing aid

11) **5,960,346 -** Apparatus and method for reducing magnetic fields in radio telephones

12) **5,819,162 -** Electro-magnetic interference shield for a telephone handset

13) **5,796,821 -** Hearing aid telephone interconnect system

14) **5,768,397** - Hearing aid and system for use with cellular telephones

15) **5,666,125 -** Radiation shielding and range extending antenna assembly

16) **6,307,944 -** System for mitigating RF interference in a hearing aid

17) **6,307,151 -** Technique for reducing low frequency interference noise

18) **6,205,190 -** System and method for reducing interference generated by a CDMA communications device

19) **6,137,888 -** EM interference canceller in an audio amplifier

20) **5,883,927 -** Digital wireless telecommunication device for reduced interference with hearing aids

21) **5,842,115 -** Time-duplex wireless telephone with improved hearing-aid compatibility

22) **5,824,967 -** Ear muffler

23) **5,812,938 -** Reverse link, closed loop power control in a code division multiple access system

24) 5,812,936 - Energy-efficient time-division radio that reduces the induction of baseband interference

25) **5,553,152 -** Apparatus and method for magnetically controlling a hearing aid

26) **5,517,113 -** Five coil measuring system for measuring magnetic field strength emanating from a telephone handset

27) **5,500,629 -** Noise suppressor

28) **20010041602- Applied November 15, 2001 -** Integrated Hearing Aid For Telecommunications Devices

VIII. Innovations are being made in wireless hearing aid coupling

Later in these comments we pointed out that where the free market has been allowed to operate, in multiple technologies are offered. In fact there is a very active investigation into means to provide wireless coupling to hearing aids. The following partial list of recent patents gives evidence that the T-Coil developed in the 1940's is not the only technical choice. The Commission should not mandate a single solution and deny consumers the benefits of new innovations.

1) **6,335,973 -** System and method for improving clarity of audio systems
2) **6,330,339 -** Hearing aid
3) **6,226,605 -** Digital voice processing apparatus providing frequency characteristic processing and/or time scale expansion
4) **6,219,635 -** Instantaneous detection of human speech pitch pulses
5) **6,173,062 -** Frequency transpositional hearing aid with digital and single sideband modulation
6) **6,169,813-** Frequency transpositional hearing aid with single sideband modulation
7) **6,073,100 -** Method and apparatus for synthesizing signals using transform-domain match-output extension
8) **6,061,431 -** Method for hearing loss compensation in telephony systems based on telephone number resolution
9) **6,023,513 -** System and method for improving clarity of low bandwidth audio systems
10) **5,884,260 -** Method and system for detecting and generating transient conditions in auditory signals

11) **5,794,201 -** Digital acoustic signal processing apparatus

12) **5,754,661 -** Programmable hearing aid

13) **5,737,706 -** Power system supporting CDPD operation

14) **5,721,783 -** Hearing aid with wireless remote processor

15) **5,717,818 -** Audio signal storing apparatus having a function for converting speech speed

16) **5,365,233 -** Method for digitizing a band-limited, analog signal, analog-digital processing unit to implement the method, a method for digital filtering and a digital filter for its implementation

17) **5,327,506 -** Voice transmission system and method for high ambient noise conditions

18) **5,321,761 -** Piezoelectric sound generator and method of its manufacture

19) **5,251,263 -** Adaptive noise cancellation and speech enhancement system and apparatus therefore

20) **4,815,140 -** Circuit arrangement for suppressing oscillations

21) 4,403,118 - Method for generating acoustical speech signals which can be understood by persons extremely hard of hearing and a device for the implementation of said method

22) **20010007050-** Hearing apparatus - **Applied - February 9, 2001**

23) **6,041,129 -** Hearing apparatus

24) **5,663,727 -** Frequency response analyzer and shaping apparatus and digital hearing enhancement apparatus and method utilizing the same

25) **6,157,114 -** Mechanical signal processor comprising means for loss compensation

26) **6,092,422 -** Mechanical signal producer based on micromechanical oscillators and intelligent acoustic detectors and systems based thereon

27) **5,930,230 -** High data rate CDMA wireless communication system

28) **5,926,500 -** Reduced peak-to-average transmit power high data rate CDMA wireless communication system

29) **5,796,848 -** Digital hearing aid

30) **5,721,783 -** Hearing aid with wireless remote processor

31) **5,615,302 -** Filter bank determination of discrete tone frequencies

32) **5,793,875 -** Directional hearing system

IX. The FCC's current rules stifle innovation

The Commission should encourage and assist innovation in accessibility, just as it does in other areas of the telecommunications industry. There are two areas relative to the issue of wireless hearing aid compatibility where the current rules prevent innovation. The first is in the current Part 68 rules, that mandate an implementation, the T-Coil, rather than a solution. It should be noted that the US Architectural and Transportation Barriers Compliance Board (Access Board) worded its telecommunications access guidelines[12] more broadly, as follows:

> § 1193.43 Output, display, and control functions.
>
> (i) Hearing aid coupling. Where a product delivers output by an audio transducer which is normally held up to the ear, provide a means for effective wireless coupling to hearing aids.

Certainly wireless coupling is currently an equivalent term for T-Coil, but this language leaves the door open for innovation and improved alternatives to be introduced.

Where the free market has been allowed to operate, in the auditorium system or Assistive Listening System (ALS) market, several alternative technologies have been introduced. In assistive listening system market, in addition to Induction Loop (IL) systems, which are

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similar in technology to T-Coils, there are FM and Infrared systems. In its bulletin on ALS systems the US Access Board reviews IL systems as follows[13]:

> **Induction Loop**
> In the first type, the induction loop (IL) system, a loop of wire encircles the listening area or is embedded in a mat placed under a rug. This loop of wire is connected to the amplifier output of a public address (PA) system instead of, or in addition to, the usual loudspeaker (input is through the microphone serving the PA system). The IL system produces an electromagnetic field around the wire that can be picked up by a telecoil in a hearing aid. About 30% of hearing aids include T- coils, which also facilitate telephone communication. When the electromagnetic field emanating from the wire loop intersects these coils, it "induces" an alternating electrical current in the coil. This electrical current is then processed by the hearing aid in the same way a microphone processes acoustical signals. The major advantage of IL systems is that listeners whose hearing aids include T- coils always have an ALS receiver with them.
>
> Facilities that provide an IL system must also provide telecoil receivers for people who do not use hearing aids or who wear hearing aids that do not have telecoils. These special receivers come in various shapes and sizes, but all contain a wire coil to detect the electromagnetic field and an amplifier to increase the signal level.
>
> Disadvantages of IL systems can include spill-over of the magnetic field into adjacent areas (both horizontally and vertically), susceptibility to stray electromagnetic fields, variations in the electromagnetic field within the loop, and issues related to the quality and physical orientation of the telecoils. With a proper installation and appropriate hearing aids, these problems can be minimized and often eliminated.
>
> …..
>
> **What principles govern the selection of ALSs for specific venues?**

13 U.S. Architectural and Transportation Barriers Compliance Board, Bulletin 9B, "Assistive Listening Systems: For Installers". Available at www.access-board.gov.

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> Except for a few specialized locations (like schools for the deaf), IL systems are rarely used in large listening venues. This is ironic, since of all the ALSs, they are probably -- from the viewpoint of the facility -- the simplest system to provide.

So, in the ALS market, where government regulations, the Americans with Disabilities Act, mandates a solution but does not prescribe the technology, multiple technologies are offered. Despite the IL system being the easiest to provide it is rarely used. Similarly, where the consumer has a choice, when buying a hearing aid, only 1 in 5 chooses the T-Coil. At a minimum the consumer appears to be signaling that the T-Coil system is not meeting their expectations.

We recommend that the Commission encourage innovation, assure the accessibility of the telecommunications system but refrain from mandating an implementation.

X. Current FCC rules in Part 24 block innovation in antenna design

The Commission rules, in Part 24[14], unintentionally but effectively prevent exploration of another promising area of innovation, antenna design in the mobile telephone. Part 24.232(b) states:

> Mobile/portable stations are limited to 2 watts e.i.r.p. peak power

e.i.r.p. is defined as:

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14 47 CFR 24

Equivalent Isotropically Radiated Power (e.i.r.p.). The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

In this specification there are in fact two requirements, a limit of 2 watts of radiated power and the requirement that this power be radiated isotropically. This means that the power must either be evenly spread in all directions or the power must be reduced until the highest peak is the same as if the power had been evenly spread in all directions. This prevents investigation of antennas that radiator more away from the user.

The RF Exposure limits, measured in Specific Absorption Rate (SAR) set strict limits on the amount of RF energy that may be radiated toward the user. However, the manner in which Part 24.232(b) is specified requires power to be radiated in all directions, including toward the user.

If this paragraph were changed to simply limit power to 2 watts innovative designs could then be explored.[15] The RF exposure requirement would properly maintain strict limits on the power radiated toward the user. A 2 watt power limit would mean that innovative designs more away from the user could be explored without assuming the liability of a total power reduction. Indeed there is currently a mobile phone on the market in Europe that radiates more away from the user by 3-4 dB. The phone works very well and has lower fields on the user side, which would tend to reduce hearing aid interference. However, this innovative design could not comply with the current Part 24.232(b) requirement as written.

XI. Conclusions

15 The Commission will recognize that in other parts of its rules a similar approach is taken as is recommended here, only the total radiated power is limited. In Part 15 a different approach is taken. In Part 15 directional antennas are allowed but with increased directionality there is a reduction in power. The reduction in power still allows for a net benefit from the directionality. While the simple total power limit is both simpler and more flexible the approach of Part 15 would also allow innovation.

In these comments we have recommended the following actions:

1. The Commission should gather factual data of the effectiveness of the current wireline HAC requirements before take further action to extend them. We have documented that at best these requirements only potentially serve the 6% of people with hearing loss that own T-Coil equipped hearing aids. However, the number of people with hearing loss who regularly use their T-Coil and find the T-Coil an effective solution appears to be only 1 - 3%.
2. The Commission should not base its decision on old data but instead should look at the current situation relative to the problem of RF interference and hearing aid RF immunity.
3. The Commission should not require a single solution to this multifaceted and complex problem if multiple, complimentary solutions are more effective in resolving the issue.
4. The Commission should bring the information it gathers to the ANSI ASC63 committee and work with it to refine and improve the standard that appears to be working very effectively.
5. The Commission should consider revising the Part 68 rules to allow alternative solutions to T-Coil.
6. The Commission should revise Part 24.232 to eliminate the isotropic radiation component of the radiated power limit.

Respectfully submitted,

AAES

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